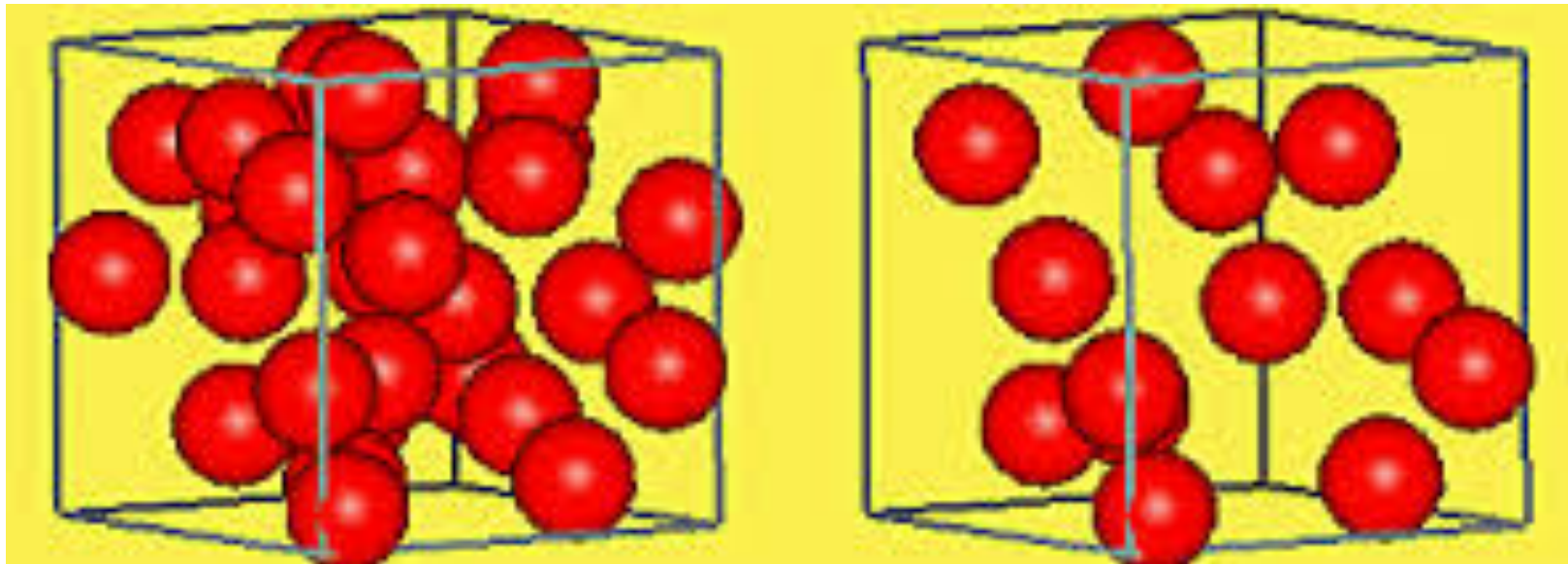


# DENSITY



# A. MASS



1. SI Base unit: kilogram (kg)

2. Can be measured in g

3. Tools: Triple beam balance, digital balance

How much matter an object is made up of  
[How much matter is in an object]

**NOT THE WEIGHT --- WEIGHT IS DEPENDENT  
ON GRAVITY!!!!**

## MASS VERSUS SIZE

WHAT IS MASS?

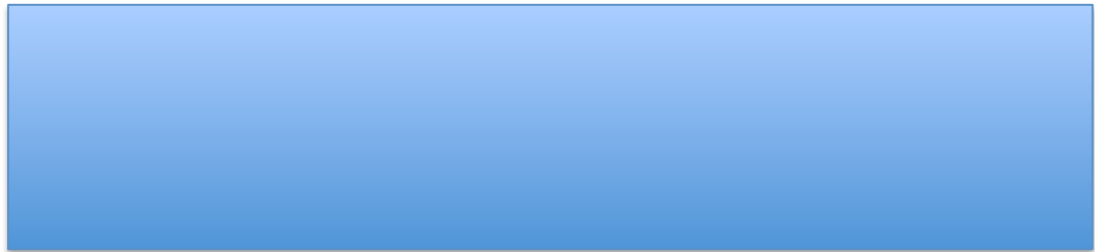
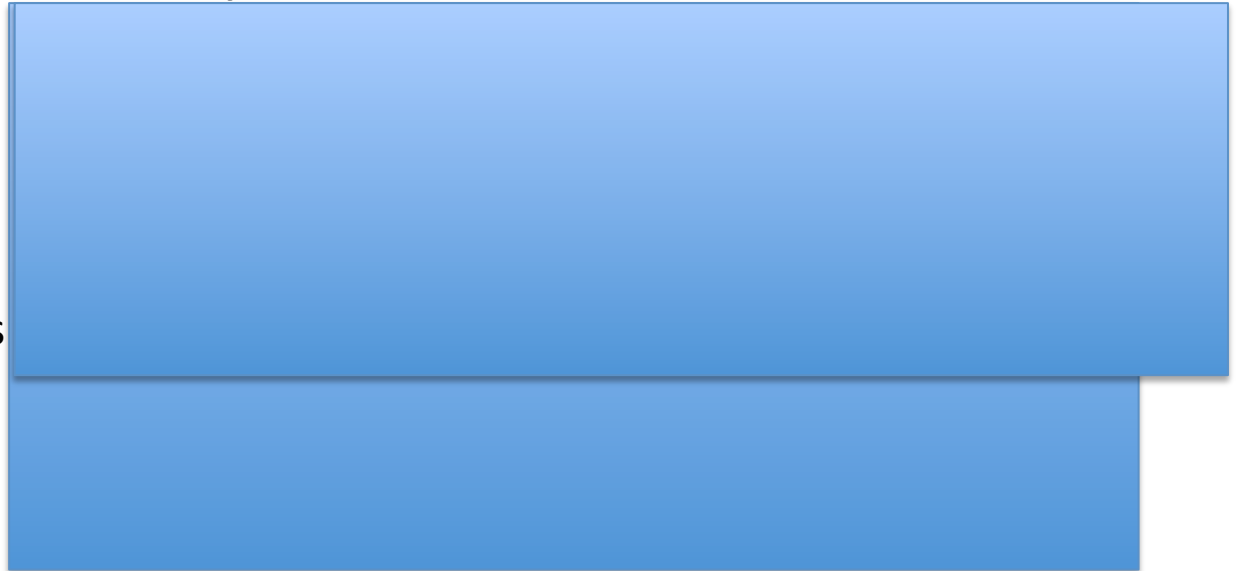
WHAT IS SIZE?

Objects are made up of “stuff” called matter. Besides taking up space and having energy, a basic property of matter is MASS

This is the amount of matter an object has or an object is made up of!

Objects made up of steel or concrete always have more mass than objects made up of styrofoam

Large objects always have more mass than small objects

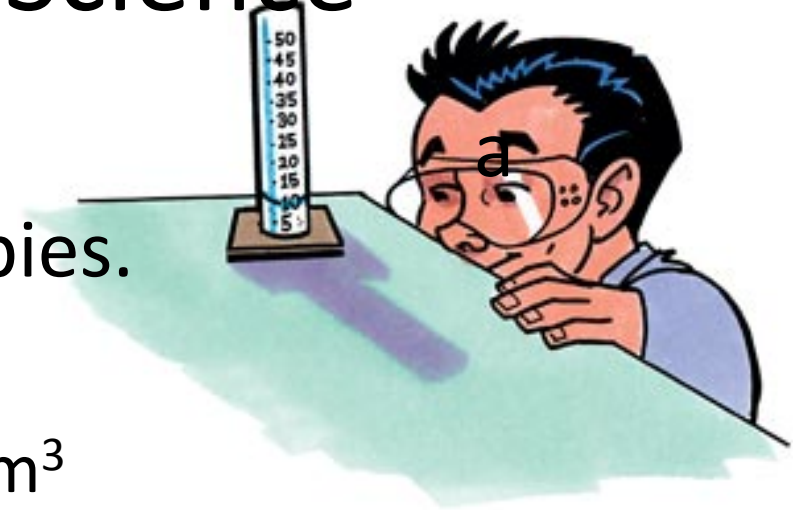
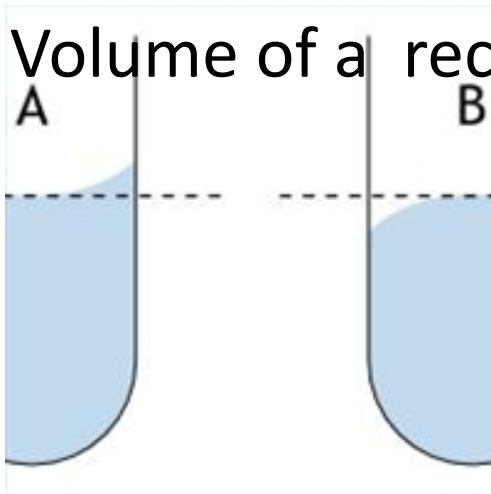


# The Nature of Science

**B. VOLUME:** amount of space a substance or an object occupies.

1. SI Base unit: liter (L)
2. can be measured in mL,  $\text{cm}^3$ ,  $\text{m}^3$
3. Tools: metric ruler (solids) or graduated cylinder (liquids, irregularly shaped solids).

4. Volume of a rectangle = Length x Width x Height





# Volume

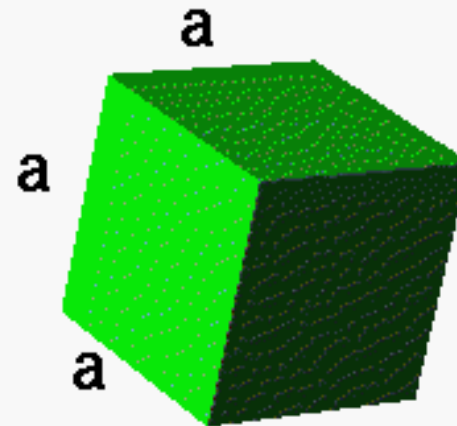
Glenn  
Research  
Center

Sphere

$$V = \frac{\pi d^3}{6}$$



Cube



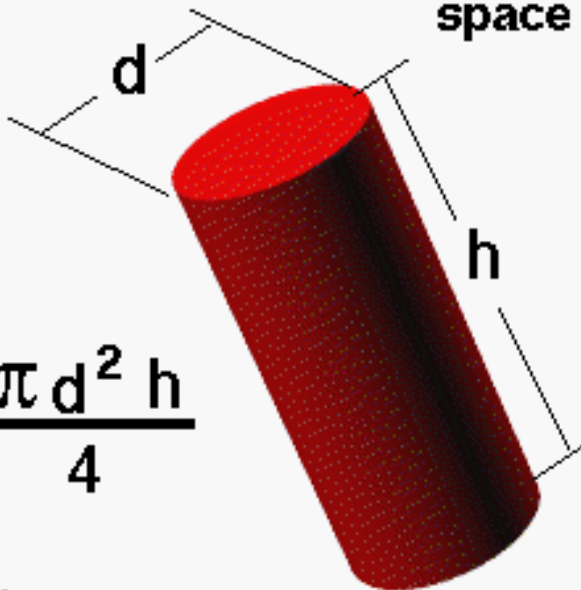
$$V = a^3$$

Volume is the  
three-dimensional  
space occupied by an  
object.

$$V = \pi r^2 h$$

OR

$$V = \frac{\pi d^2 h}{4}$$



Cylinder

Can be  
measured  
In  $\text{cm}^3$ ,  $\text{ft}^3$ ,  
 $\text{m}^3$  etc

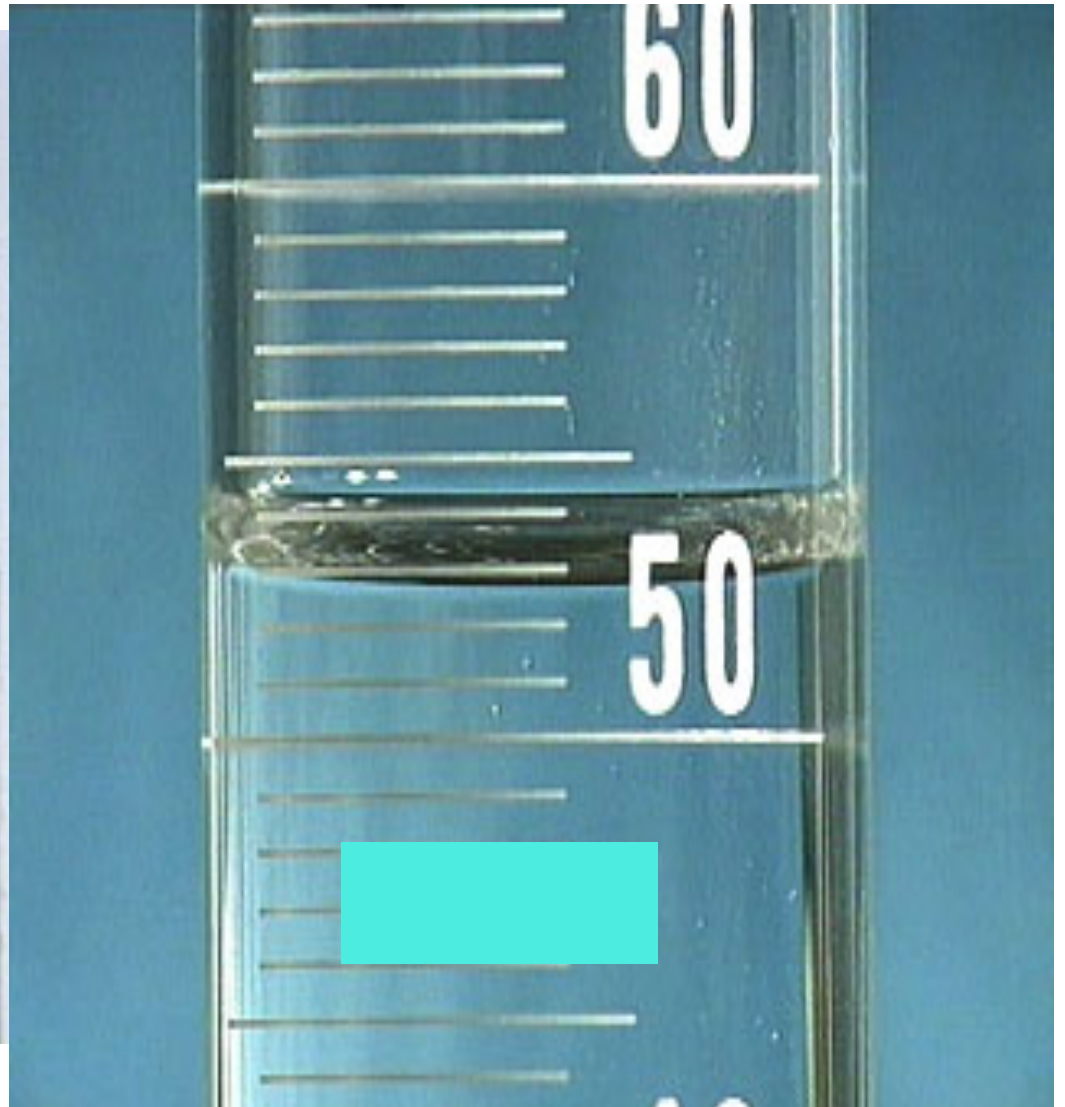
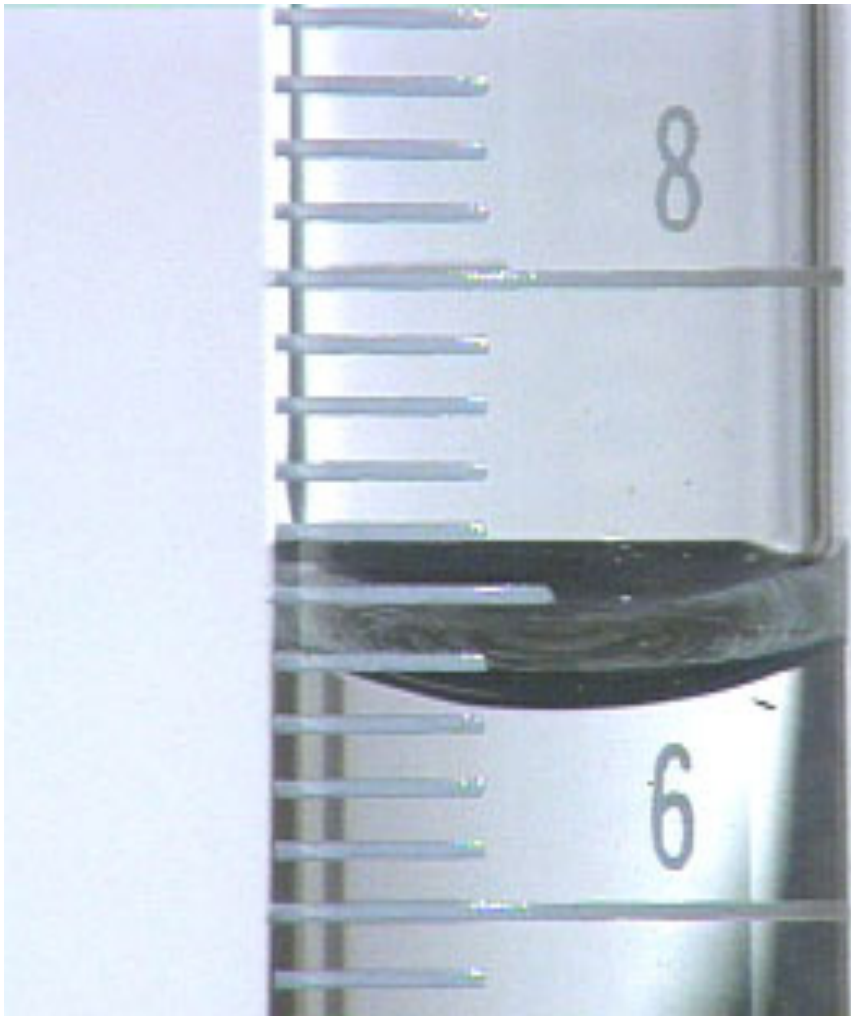
$$V = l \times w \times h$$



$$V = a b h$$

Rectangular Prism

Can be measured in L (liters) or mL (milliliters)





# The Nature of Matter

C. Density : amount of matter contained by a given volume

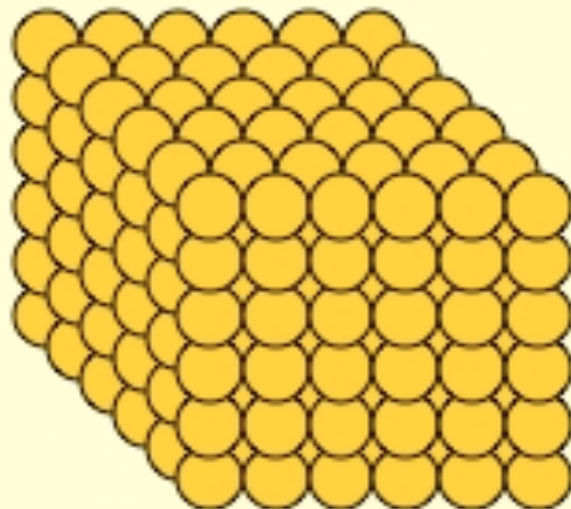
$$D = \frac{m}{V} = \frac{\text{mass}}{\text{volume}}$$



Watch 30 rock – youtube

<http://www.youtube.com/watch?v=zKMDI9P3goI>

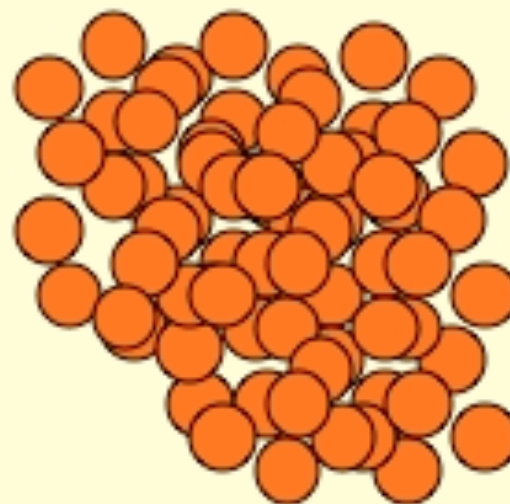




**HIGH DENSITY**

particles are packed together  
tightly - not much space between.

(Will sink easily, e.g. iron nail)



**LOW DENSITY**

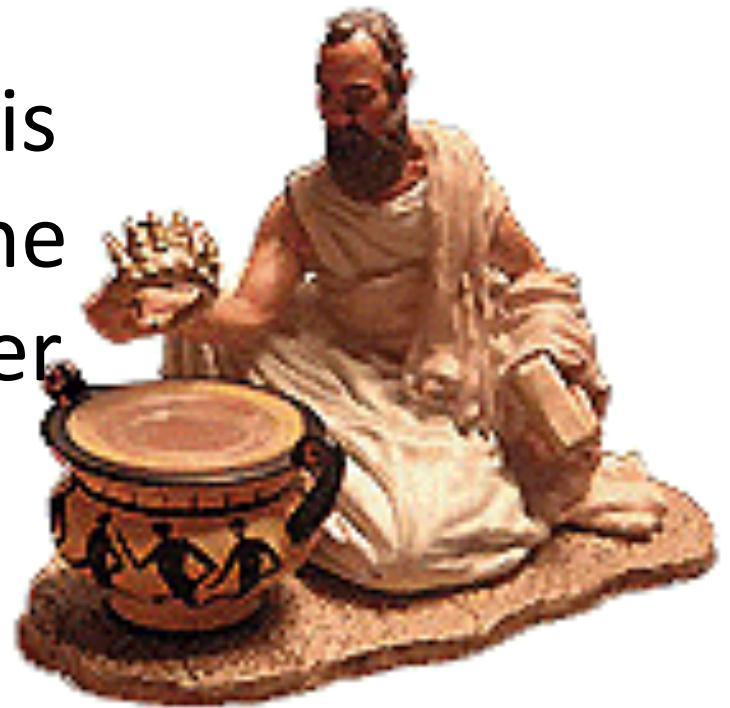
particles are loosely packed  
together - more space between.

(Will float more easily, e.g. wood )



# Archimedes and the gold crown

Exposed false manufacturing of gold crowns using the density of gold and silver as his evidence. Silver crown with the same mass would have a larger volume and displace more water because it has a lower density than gold. The manufacturer was replacing gold with less expensive silver!



# Density of water

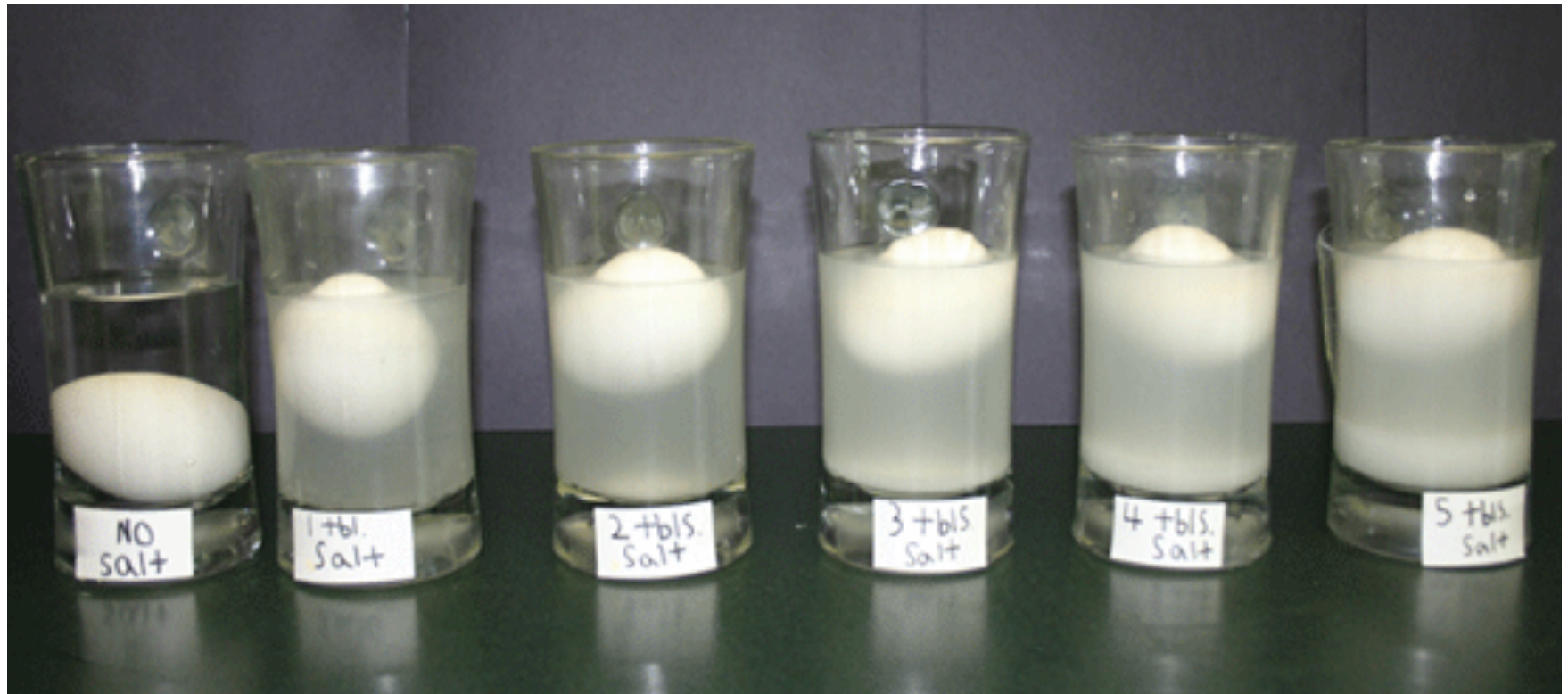
- The density of water is

- $1 \text{ g/mL}$

- Think about this .....
- 1 mL of water has a mass of 1 g or  $1 \text{ cm}^3$  has a mass of 1g



# Sink or float



# Density column



What must be true about the red liquid compared to the yellow liquid?

How is this possible to form such distinct layers?

What would happen if the colors were added in a different order?

# Why do ships float?



Because they have a large:



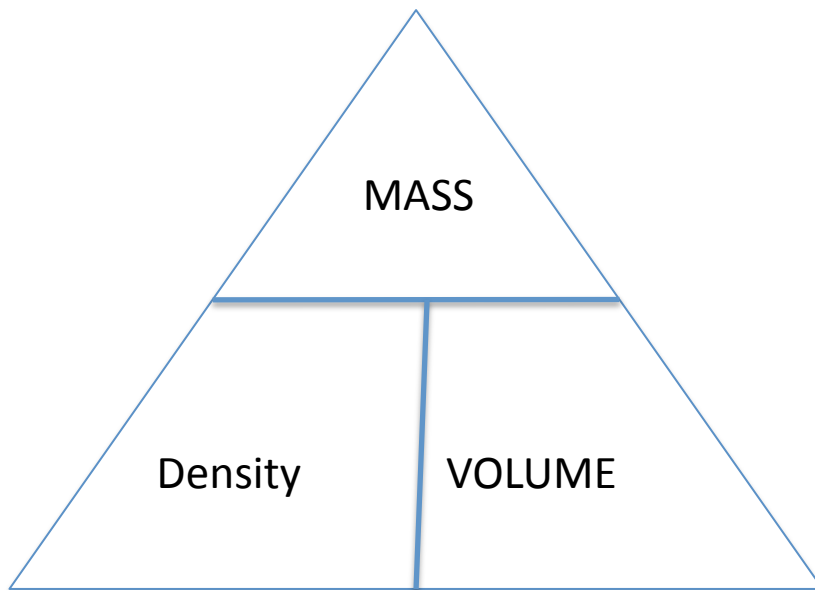
Density of steel =  $7.8 \text{ g/cm}^3$

Density of water =  $1 \text{ g/cm}^3$

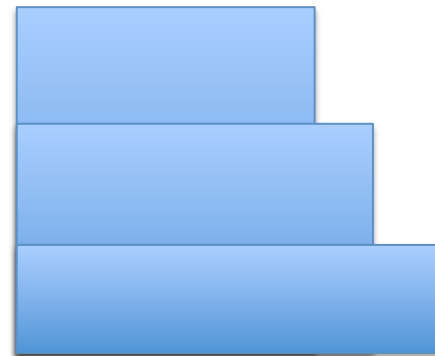




# Density triangle



To find the equation for the variable you are looking for, cover that variable up.



# The Nature of Matter

## Finding Density

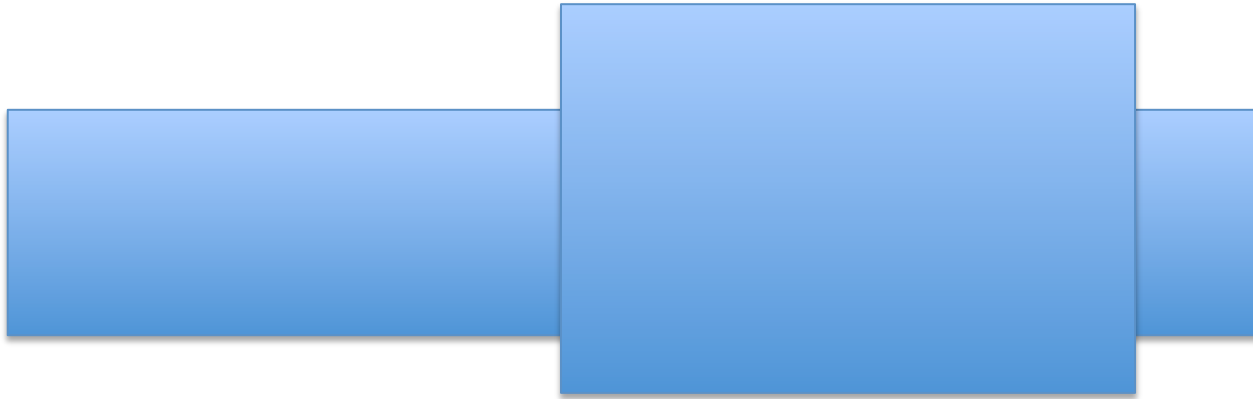
Calculate the density of a material that has a mass of 52.457 g and a volume of 13.5 cm<sup>3</sup>



# The Nature of Matter

## Finding Density

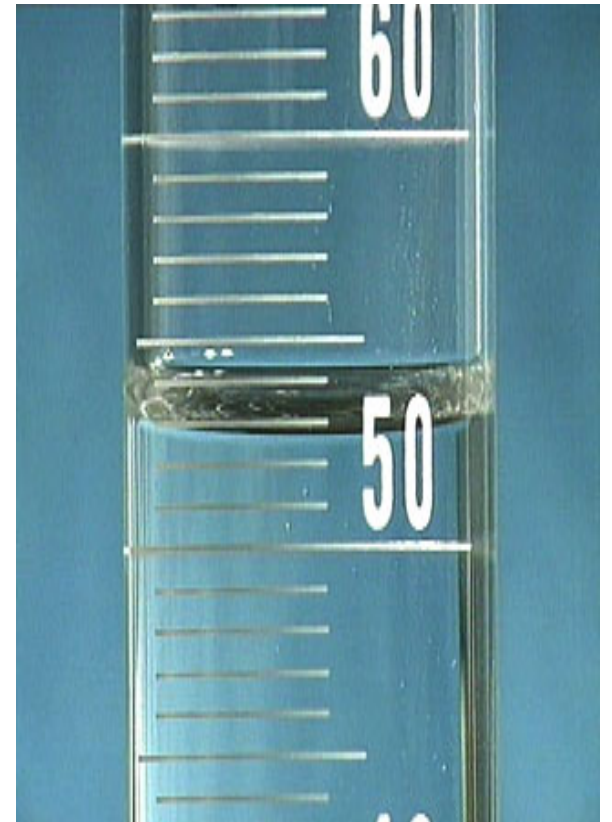
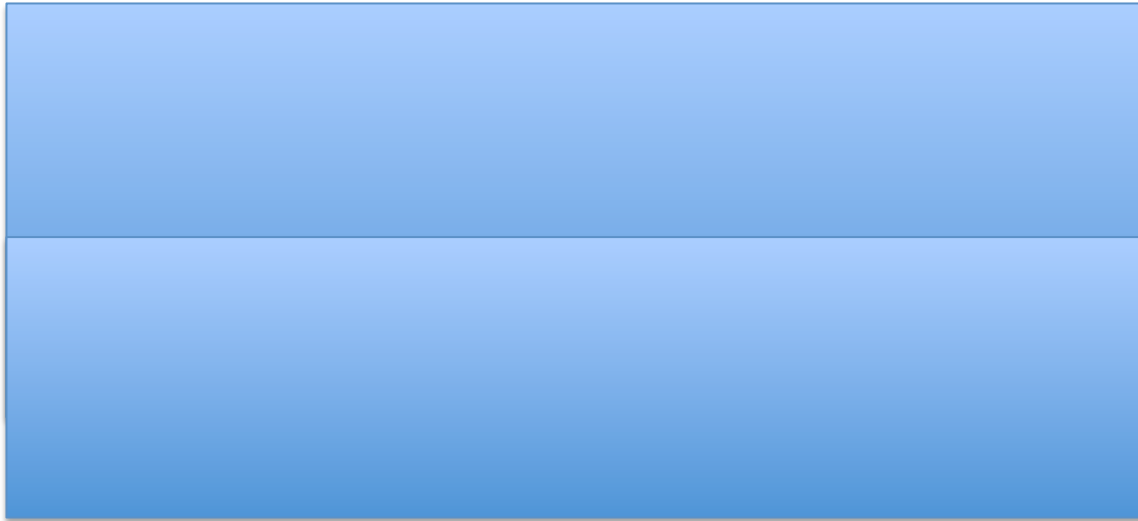
Calculate the density of a substance that has a mass of 29.2 g and a volume of 113.9 cm<sup>3</sup>



# The Nature of Matter

## Finding Density

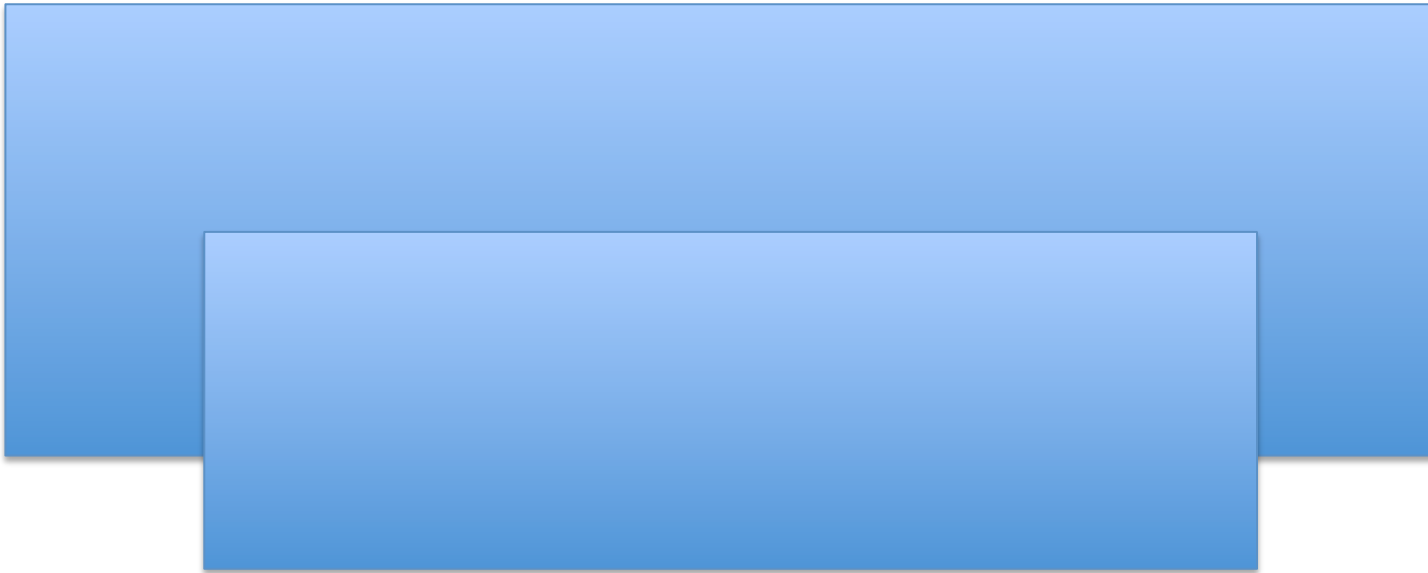
Find the density of an object that has a mass of 0.013 kg and is placed in a graduated cylinder that originally has a volume of 48.3 mL



# The Nature of Matter

## Finding Mass

- The density of silver is  $10.49 \text{ g/cm}^3$ . If a sample of pure silver has a volume of  $12.993 \text{ cm}^3$  what would the mass be?



# The Nature of Matter

## Finding Volume

- Pure gold has a density of  $19.32 \text{ g/cm}^3$ . How large would a piece of gold be if it had a mass of  $318.97 \text{ g}$ ?

